

S. Dak., Saint Paul, Minn., Sandusky, Ohio, Sioux City, Iowa, Toledo, Ohio, and Williston, N. Dak. On December 11 the following additional places reported ice of 2 inches or more in thickness: Bismarck, N. Dak., Detroit, Mich., Erie, Pa., Kearney, Nebr., Port Huron, Mich., and Rochester, N. Y. On December 18 the following additional places were reported: Albany, N. Y., Alpena, Mich., Chicago, Ill., Harrisburg, Pa., Sault Ste. Marie, Mich., and Yankton, S. Dak. On December 25, at 8 p. m., there was practically no ice in the lower lake region, and thence southward; no change in the thickness of ice was reported from Albany, N. Y., Green Bay, Wis., Dubuque and Sioux City, Iowa; the thickness was 22 inches at Williston, N. Dak. By January 1 the ice in the upper Missouri was 4 to 5 inches thicker; from Detroit, Mich., to Mackinaw, Mich., on Lake Huron, ice was 3 to 7 inches thicker than on December 25. The Mississippi at and below Davenport, Iowa, and the Hudson at and below Albany, N. Y., were then free from ice. A half-inch of ice was reported in the Susquehanna at Harrisburg, Pa.

The following special reports have also been collected:

Buffalo Creek.—Buffalo, N. Y., 16th, one of the most disastrous floods which the Buffalo Creek territory has ever suffered came with the thaw and rain of yesterday. The creek rose 20 feet last night, overflowed its banks, and left 4 feet of water over the whole territory known as South Buffalo.

Connecticut River.—Hartford, Conn., 12th, closed for navigation. New Haven, Conn., 14th, navigation closed.

Detroit River.—Detroit, Mich., 2d to 12th, floating ice; 15th, navigation closed; 20th, frozen, but ice soon broken by ferry boats.

Hudson River.—Albany, N. Y., 4th, floating ice; 5th, last boat of the season left at 5 p. m.; 6th, frozen in the morning; 9th, gorged near Kinderhook Light, traffic blocked; 10th, ice gorge remained firm between the upper and lower Kinderhook Lights; 16th, navigation closed from Albany to Poughkeepsie; 25th, ice reported as moving south of Kinderhook; 26th, ice moved during the night, and reported as gorging to the south of Greenbush Bridge; 29th, free from ice. Kingston, N. Y., 13th, temperature at zero all day; frozen solid north of city and people walking across from Heath to Barrytown; earliest closing north of here in many years; south of city navigation going on, but there is considerable floating ice.

Illinois River.—Havana, Ill., 1st, closed for navigation, but opened after 15th.

Kennebec River.—Gardiner, Me., 2d, closed. Bath, Me., 14th, frozen the entire length of the city.

Mississippi River.—Saint Paul, Minn., 12th, generally frozen, except a very narrow strip along the bank in front of city. River-gauge readings suspended. Dubuque, Iowa, 1st, closed by ice. Fort Madison, Iowa, 28th, ice passed out of river. Keokuk, Iowa, 3d, ice gorge formed south of station; 4th, river frozen; 18th, gorge broken by northwest gale; 31st, light running ice. Davenport, Iowa, 2d, river frozen; 25th, ice in river broke up above city and began moving about again but soon became blocked in the afternoon; 28th, ice went out of river at the bridge during the early morning; river

full of floating ice. Warsaw, Ill., 1st, river full of floating ice; 3d, river frozen. Saint Louis, Mo., 3d to 6th, floating ice.

Missouri River.—Greenwood, S. Dak., 2d, frozen and teams crossing on ice. Santee Agency, Nebr., 2d, frozen; 16th, crossed by teams. Sioux City, Iowa, 1st, frozen and navigation closed. Bluffton, Mo., 1st, floating ice. Boonville, Mo., floating ice; 4th, gorged above; 15th, gorge broken; 16th, heavy ice. Hermann, Mo., 1st, navigation closed.

Ohio River.—Wheeling, W. Va., 6th to 9th, 14th, 22d to 24th, floating ice.

Penobscot River.—Orono, Me., 4th, closed by ice.

Saint Croix River.—Calais, Me., 13–14th, frozen solid from the bridge to the narrows.

Saint Lawrence River.—A dispatch to the "Utica Herald" from Clayton, dated 14th, says that the weather is the coldest experienced in that locality in years, 18° below zero. The river is practically frozen over. As far as the eye could see no open water appears, and the dense fog steaming from the water that had almost hidden it for the past few days had all disappeared. It is the first time within the recollection of the oldest residents that the river has frozen over so early in the winter, and with so little snow—not enough for sleighing.

Saint Marys River.—Sault Ste. Marie, Mich., 4th, last boat bound down Lake left to-day; 6th, navigation closed; 19th, frozen.

Susquehanna River.—Lock Haven, Pa., 2d, west branch frozen; 17th, slush ice.

Wabash River.—Lafayette, Ind., 18th, full of floating ice.

Erie Canal.—Rochester, N. Y., closed for navigation.

Susquehanna Canal.—Selins Grove, Pa., 5th, navigation closed.

Lake Superior.—Duluth, Minn., 8th, the last steamer of the season arrived to-day.

Lake Michigan.—Green Bay, Wis., 1st, the schooner "Bacon" arrived, and was the last boat of the season to arrive; 3d, two steamers left port to-day and navigation closed; 4th, ice in the river 8 inches thick. Chicago, Ill., 10th, navigation closed.

Lake Huron.—Port Huron, Mich., 1st to 4th, floating ice in Black River; 13th, two steamers passed up the Lake to-day, being the last departure, and navigation closed; 26th, the warm weather and rain during the past few days has broken up the ice in the Black River; an ice gorge formed in the river and a large number of vessels were torn from their moorings; slight damage to bridge; 30th, 31st, floating ice in Saint Clair River.

Lake Erie.—Erie, Pa., 4th, Presque Isle Bay frozen. Toledo, Ohio, 2d, river and bay frozen, tugs broke a channel through the ice; 7th, the last vessel of the season arrived to-day, navigation closed; 23d, river free from ice. Cleveland, Ohio, 5th to 9th, 11th to 14th, 16th, 20th, 21st, and 22d, floating ice in river; 11th, the last boats of the season left port to-day; 14th, the last boat of the season arrived to-day. Windsor, Ont., 7th, the ice at the head of Lake Erie has become so heavy as to form a very serious obstruction to the passage of boats, only the most powerful steamers being able to force their way through; the ice extends from the mouth of the river to Colchester Point, and a recurrence of freezing weather would close navigation to all Lake Erie ports. Sandusky, Ohio, 4th, navigation closed. Buffalo, N. Y., 16th, navigation closed.

Lake Ontario.—Toronto, Canada, 22d, the bay was frozen over last Saturday, but the subsequent high wind drove the ice all out again on Sunday; last night it was frozen over to the island once more; this is a few days earlier than the freezing of the bay took place last year. Oswego, N. Y., 11th, navigation closed on Lake Ontario.

ATMOSPHERIC ELECTRICITY.

THUNDERSTORMS AND AURORAS.

The table on p. 360 shows in detail for December, 1893, the number of stations from which meteorological reports were received; and the number of such stations reporting thunderstorms (T) and auroras (A), respectively, in each state and on each day of the month on which the phenomena were observed.

THUNDERSTORMS.

A mention of the more severe thunderstorms reported for the month is given under "Local storms."

The dates on which reports were most numerous are the 3d, 15th, 16th, 24th, and 29th.

The dates on which reports were least numerous are the 5th, 8th, 9th, 11th, 13th, 17th, 18th, and 19th.

The states from which the most numerous thunderstorm reports were received were Florida, Iowa, Louisiana, and South Carolina.

AURORAS.

The evenings on which the full moonlight must have interfered with observations were the 12th to 20th. On the

remaining 23 evenings 73 aurora reports were received, or an average of 3 per day. The dates on which the reported number especially exceeded this average were the 5th, 27th, and 29th. The only date on which both thunderstorms and aurora reports were specially numerous was the 29th. None of the auroras of December seem to have been especially brilliant.

In reference to the aurora of November 1, 1893 (see MONTHLY WEATHER REVIEW, p. 328), the observer at Marquette, Mich., reports that the display extended from the northern horizon up to an altitude of 110°, viz., to a point 20° south of the zenith. The greatest extent of the display around the horizon was from azimuth 50° around to the north to azimuth 310; the streamers extending from all this part of the horizon up toward the point 20° south of the zenith.

The observer at Havre, Mont., reports that at 9.15, p. m., the crown of the arch in the north was 40° in altitude, and the extremities of the arch were 180° apart in azimuth; at 1, a. m., November 2, the east end of the arch was 10° south of the east point of the compass, with an altitude of 90° at crown of arch.

Thunderstorms and auroras, December, 1898.

States.	No. of stations.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	Total.				
Alabama	48	T.		3													2													4	3	12	T.				
Arizona	54	A.																						1									1	A.			
Arkansas	38	T.														3			1														3	T.			
California	303	A.													1							1	2		2			3					9	A.			
Colorado	77	T.	1	1																													2	T.			
Connecticut	24	A.			1																						1						2	A.			
Delaware	5	T.																												3			3	T.			
District of Columbia	4	A.																									1						1	A.			
Florida	34	T.											1				10										1			2	3	6	23	T.			
Georgia	52	A.			5												5														3	1	14	A.			
Idaho	17	T.																																0	T.		
Illinois	55	A.														3													2				5	T.			
Indiana	40	T.	1	1													2																	4	T.		
Indian Territory	6	A.																																0	A.		
Iowa	77	T.															2																	0	T.		
Kansas	72	A.				1	2																	1	30									33	T.		
Kentucky	33	T.		3													1																	0	T.		
Louisiana	46	A.			3			1					1			4	2								1				2	5			19	T.			
Maine	20	T.																																0	T.		
Maryland	24	A.																									1							2	A.		
Massachusetts	85	T.	1			2			1																									1	T.		
Michigan	70	A.								1						1																		4	T.		
Minnesota	73	T.																																0	T.		
Mississippi	38	A.	1	2	1		4							1		2																		13	A.		
Missouri	95	T.															9																	16	T.		
Montana	21	A.									1																								1	A.	
Nebraska	72	T.																																	6	T.	
Nevada	48	A.																																	1	A.	
New Hampshire	25	T.																																	0	T.	
New Jersey	54	A.																																	4	A.	
New Mexico	20	T.																																	4	T.	
New York	75	A.																																	8	A.	
North Carolina	55	T.			8	1	1										3																	12	T.		
North Dakota	5	A.																																	0	A.	
Ohio	131	T.																																	2	T.	
Oklahoma	10	A.																																	0	A.	
Oregon	66	T.	1	1																															4	T.	
Pennsylvania	82	A.																																	4	A.	
Rhode Island	9	T.					2																												3	T.	
South Carolina	43	A.			17				1																										22	A.	
South Dakota	43	T.																																	4	T.	
Tennessee	38	A.												1			2																		5	A.	
Texas	74	T.															3																		6	T.	
Utah	29	A.	1																																1	A.	
Vermont	14	T.																																	0	T.	
Virginia	39	A.				1	1																												3	A.	
Washington	42	T.												1																					1	T.	
West Virginia	13	A.																																	0	A.	
Wisconsin	58	T.																																		6	T.
Wyoming	13	A.	1																																10	A.	
Sums	2,479	T.	5	8	39	4	0	2	2	0	1	1	0	4	0	1	32	24	0	0	0	1	3	4	4	53	15	1	5	4	27	8	6	253	T.		
		A.	2	0	0	2	13	1	0	1	0	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	2	10	3	31	1	3	77	A.			